(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 607 693 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
13.03.2002 Bulletin 2002/11

(51) Int Cl.[7]: **H04R 29/00**

(21) Application number: **93310353.3**

(22) Date of filing: **20.12.1993**

(54) Method and apparatus for diagnosing AMP to Speaker Connections

Methode und Gerät zum Testen von Verbindungen zwischen Verstärker und Lautsprecher

Procédé et appareil pour tester des connexions entre un amplificateur et un haut-parleur

(84) Designated Contracting States:
DE FR GB

(30) Priority: **07.01.1993 US 11688**

(43) Date of publication of application:
27.07.1994 Bulletin 1994/30

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Description

[0001] The present invention relates generally to a communication apparatus, and more particularly to DSP communication devices having diagnostic capabilities.

[0002] In the production of communication systems such as radios and in the production of vehicles which includes the installation of radios, it is well known to test the communication apparatus before delivery to the customer. In view of the numerous components employed in such systems, and the distribution of such components throughout a vehicle in which it is installed, a point-by-point inspection of all the connections between components in the system is very difficult if not impossible. Moreover, it may be appreciated that visual inspection may not readily identify electrical connection problems which can render the system inoperative or raise the risk of damage to those components improperly connected. Accordingly, diagnostic devices have been developed in order to test the operation of the communication systems.

[0003] One previously known form of apparatus for testing communication systems involves a separate apparatus which is adapted to interact with various portions of the system. For example, radio tuners, amplifiers, demodulators and the like may be tested by interacting with the circuitry in the testing apparatus. Likewise, the testing circuitry may emit signals which are transferred to other portions of the system to determine the functioning of certain-controls or circuits such as the tone controls, speakers or a graphic equaliser. However, such systems require connection of the testing apparatus with portions of the radio being tested and must be accomplished by disconnecting portions of the system for reconnection to the test apparatus. As a result, the preparation for testing of the radio system with these previously known test apparatus can be laborious, difficult and time consuming to perform.

[0004] In the patent specification DD-A-267 616 there is described a measurement method and apparatus for a communication system comprising a processor connected through an I/O coupling to a D/A converter. The D/A converter is coupled to a sine wave generator that feeds a loudspeaker. The loudspeaker is acoustically coupled to a receiver that feeds an A/D converter. The A/D converter is connected to supply a digital signal back to the processor through the I/O coupling. By this means, the processor can set the sine wave generator to produce a test signal that is received by the receiver. The level of the test signal returned via the receiver to the processor can be monitored to ensure a proper coupling of the loudspeaker.

[0005] It has also been known to provide the communication apparatus with self-testing circuitry. However, such circuitry, particularly circuits designed for use in an analysis of analog signals, can be quite complicated, and may substantially increase the size and expense of producing the communication apparatus. Moreover, such apparatus is often limited to testing of discreet signal functions, and does not permit variation of a single signal parameter through a range in which the communication device should operate properly. In particular, such variation may have to be performed manually and thus requires experience and expertise in order to operate the testing equipment properly.

[0006] In addition, while parts of the communication system, for example, the radio tuner, may be inspected at the factory for operation before installation in the vehicle, it is necessary to determine that the communication system is functional once it has been installed in the vehicle. Nevertheless, the previously known test apparatus do not permit detection of whether the entire system has been properly installed in a vehicle or other environment. In particular, the installation of a system often requires widely distributed speakers to be connected to the amplifier. In light of recent improvements in audio reproduction systems, where concert hall emulation and other features have been made available by digital signal processing, the operation of each speaker within the system has greater importance than in previously known mono or stereo systems since each speaker has a distinct contribution to the audio output and is not merely a redundant audio source. Accordingly, the connection between each speaker and an amplifier is very important to system operation but is very difficult to monitor within the assembled vehicle.

[0007] The present invention overcomes the above-mentioned disadvantages by providing a communication system with self-diagnosis circuitry for determining the status of the amplifier-to-speaker connection. In general, the system generates an input to an amplifier, and the output of the amplifier is tested to determine the status of the amplifier output, without requiring the disassembly or reconnection of testing apparatus to the installed communication system. In addition, the system performs a diagnostic routine using the existing control mechanism of the communication system and does not require a substantial amount of additional components to be installed with the communication system.

[0008] According to the present invention there is provided a method for diagnosing an electrical connection between a power amplifier and a speaker in a communication system, comprising:

initiating a diagnostic routine by selecting a predetermined input on a control unit;
generating a predetermined tone signal in response to the input selected;
applying said tone signal to aid amplifier;
detecting the output from said amplifier;
varying the level of said tone signal;
monitoring the level of tone signal at which clipping occurs at an output from the amplifier; and
indicating whether clipping commences within a predetermined range of tone signal levels.

[0009] Further according to the present invention there is provided a DSP communication system comprising a diagnostic circuit to diagnose an electrical connection between a power amplifier and a speaker in the communication system, comprising;

a control unit having means to initiate a diagnostic routine by selecting a predetermined input on the control unit;
a DSP processor unit including a programmed means to generate a predetermined test signal in response to the said predetermined input and to control the magnitude of the test signal; and
a DA converter for applying the test signal to the power amplifier;

characterised by;

a detector connected at an output from the amplifier for determining a threshold level at which said amplifier generates a clipped output;
a monitor for determining the magnitude level of the test signal at the threshold level of detected clipping; and
means for indicating whether the amplifier is properly coupled to a speaker by comparing the detected level of the signal at clipping with a predetermined range of levels.

[0010] In the preferred embodiment, a digital signal processor includes a generator for generating an input signal at a predetermined level to the amplifier. Preferably a feedback signal identifies the amplitude level of the generated signal. In addition, a clip detector advises of the occurrence of signal clipping in the amplifier. The clip detector also preferably includes a feedback loop that identifies the clipped output to a digital signal processor control apparatus (DSP).

[0011] If clipping occurs at an input signal amplitude below a predetermined level, a short circuit condition is identified by the DSP. Similarly, a detection of clipping at an input voltage amplitude greater than a predetermined level will indicate an open circuit condition between the amplifier and the speaker. In each situation, an appropriate indicia can be generated for ready recognition by testing personnel, for example, a visual display may be illuminated at the front control unit of the radio system to identify the condition detected. If the clipping occurs within a predetermined range of input voltages delivered to the amplifier, the equipment is in proper operating condition, and the condition of the circuit may also be indicated by appropriate indicia generated as a result of the test.

[0012] The diagnostic cycle may be invoked by a certain key press, for example a combination of controls on the front control unit of the DSP radio. Preferably, the DSP generator would generate a generally inaudible tone, that is, a tone in a frequency range to which the human ear is less sensitive e.g. 19 KHz, so that the operator would not be annoyed by the tone during the test procedure. A plurality of speakers may be sequentially tested with the apparatus.

[0013] The present invention to provides a method and apparatus for diagnosing radio circuit conditions such as the electrical connection between an amplifier and speaker within the system itself without increasing packaging space required for the system. The amplifier to speaker connection by is diagnosed initiating a diagnostic routine on the radio control unit, generating a signal and applying it to the amplifier, detecting the amplifier response, monitoring the level at which clipping occurs and indicating whether the level at clipping represents an acceptable performance condition in the connection. The input signal level is automatically varied while continuing the above steps to determine a clipping threshold level representative of the connection status.

[0014] The DSP radio system includes a diagnostic initiator employing the radio function control unit and a programmed processor for generating a test signal to be applied to an amplifier, detecting the response of the amplifier to the signal and monitoring the level at which the amplifier output is undesirably distorted and indicating the connection status as a response to the relative signal level where clipping occurs. The DSP radio system with a comparer in the DSP chip is set to compare the level of signal at the clipping threshold with a predetermined normal range of level between a level limit representing a short circuit and a signal level representative of an open circuit between the amplifier and the speaker. The DSP radio system is used to serially test all speakers in a multiple speaker system.

[0015] The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of the communication system employing the diagnostic apparatus and method according to the present invention;
Figure 2 is an enlarged front elevational view of the front control unit shown in Figure 1;
Figure 3 is a partially more detailed schematic view of a portion of the system shown in Figure 1; and
Figure 4 is a graphic representation of a load impedance to output voltage transfer function demonstrating the performance of a diagnostic apparatus according to the present invention.

[0016] Referring first to Figure 1, a communication system 10 is thereshown comprising numerous parts which are generally divided in a manner particularly adapted for installation in a motor vehicle. In particular, a front control unit 12 is adapted for mounting in the instrument panel of the motor vehicle, while a control box 14 including an AM/FM radio tuner unit 24, is mounted in the trunk of a motor vehicle along with selected accessories such as a compact disc player 15. The anten-

na 35 is mounted externally but coupled to the tuner 24. The number and positions of the accessories may be varied as desired without departing from the invention, although a cassette player 25 is preferably mounted in the front control unit for convenience. The trunk also carries an amplifier 34 coupled by conductors to a left front speaker 16, a left rear speaker 18, a right front speaker 20 and a right rear speaker 22 distributed throughout the passenger compartment of the vehicle in the preferred embodiment for convenience and audio reproduction quality. Nevertheless, the number and positions of speakers may be varied as desired.

[0017] The control box 14 also includes an analog multiplexer 41, for example, two four-input analog switches for selecting signals from the tuner 24, compact disc player 15 or tape deck 25 to an analog to digital (A-D) converter 30. Preferably, the multiplexer 41 provides a differential input to the A-D converter 30 to reduce the effect of changing environmental conditions around the vehicle. The A-D converter 30 is part of a audio signal processing chip set 26 including a digital signal processing (DSP) chip 43 (see Figure 3), a microprocessing chip 27 (See Figure 1), a digital audio signal processor (DASP) 31 (see Figure 3) and a digital to analog (D-A) converter chip 32 (see Figure 3).

[0018] In a preferred embodiment, a two-channel audio 16 bit A-D converter, such as a Philips SAA 7364, can be conveniently coupled to the DSP chip set 28. The chip set 28 includes a combination of chips such as an IC 43, for example, a Texas Instrument TMS 320C25 DSP integrated circuit and an IC chip 31, for example, a Texas Instrument TMS 57002. The D-A convertor comprises a four channel, 18 bit D-A converter 32, such as a Philips TDA 1314. This converter 32 provides two additional bits for an extra 12db (6db per bit) dynamic range improvement which enables digital fader control, rather than digitally controlled, analog fader circuitry after the converter 32, to deliver a signal to the amplifier 34 whereby the prominence of each channel 17, 19, 21 and 23 can be adjusted. The DSP chip set 28 is also coupled to a microprocessor chip 27, for example, a Motorola HC11 adapted to provide conventional serial communication, for example, SAE Standard J 1850 communications, with a compatible microprocessor chip 29, for example, another Motorola HC11.

[0019] As generally indicated in Figure 1, the front control unit 12 includes controls 42-62 accessible to the vehicle operator, and a display unit 66 for indicating the conditions of the system which have been set by the controls. As more particularly shown in Figure 2, the front control unit 12 includes a plurality of controls, such as rotary switches 42, 44 and 46, single action push buttons 48, 50, 52, 54, 56 and 58 as well as double-action push buttons 60 and 62. A display screen 66 may be provided by an LCD screen or the like which reflects the condition of the communication devices and the control settings introduced by the operator at the front control unit 12.

[0020] While each control selector may ordinarily have a single function, each control can be used in combination with other controls to select functions not normally associated with the use of the communication devices. For example, while the switch 62 might often be used for play and rewind functions for a cassette player receptacle generally designated at 68, a right side activation of the double switch buttons 60 and 62, together with a simultaneous depression of switch 58, may be employed as an initiator for generating a diagnostic program as used in the present invention. In particular, it will be understood that such multiple switch engagement forms an actuator controlling the communication system in a manner substantially different from the individual actuation of the individual controls on the front control unit 12. Regardless of the control combination selected to initiate the diagnosis routine, the control signal is delivered through the microprocessor 27 to the digital signal processing microprocessor 28.

[0021] Referring now to Figure 3, upon actuation of the diagnostic prompting switch combination, such as the 58, 60 and 62 combination above, the DSP microprocessor 28 is initiated to generate a tone signal at maximum output as indicated diagrammatically at 70.

[0022] In the preferred embodiment, a clip detector feedback loop 74 is provided using an audio limiter function such as is provided by the audio power amplifier IC's previously identified. For example, the amplifier 34 of the preferred embodiment includes four SGS Thompson Model L109 integrated circuits, one for each channel shown in Figure 1. However, in Figure 3, the multiple channels of the preferred embodiment are generically represented by a single channel comprising conductors 76 and 78 and speaker 80. The clip detector loop 74 provides a clip detection signal, such as a 0 (low) voltage signal generated by the SGS-L109, when the output of the amplifier 34 begins to clip and introduces a significant level of distortion of the output signal. The signal is introduced through an interrupt pin of a signal limiter 31, for example, a Texas Instruments TMS 57002, which continuously reduces the signal level introduced to the D-A converter 32 linearly. Such feedback quickly establishes the limit at which distortion of the amplifier output reaches an acceptable level.

[0023] An audio level detector loop 72 is input to the DSP 28 by a digital multiplexer switch 33, for example, common logical gating that performs two-to-one multiplexing. If the clipping threshold detected occurs at a level of signal 70 which is within a predetermined range corresponding to an acceptable or normal impedance range 90 as shown in Figure 4, it will be understood that the conductors 76 and 78 form a complete circuit between the amplifier and the speaker terminals on speaker 80. The acceptable range is dependent upon the variable impedance which may be presented by one or more speakers 80 (for example, the left front 16, left rear 18, right front 20 and right rear 22) connected to the conductors 76 and 78 (for example, each conductor pair of

the channels 17, 19, 21, and 23, where a single speaker is coupled to the conductors) in each channel and the total number of channels.

[0024] If the microprocessor determines that the level of a signal 70 at the threshold of clipping is below the predetermined, normal range, a shorted connection across the speakers would be detected as indicated to the left of 90 in Figure 4. Similarly, if the level was higher than the predetermined range 90 when clipping threshold is detected, an open circuit connection would be identified across the conductor pair intended to couple each speaker with the amplifier 34, as illustrated to the right of 90 in Figure 4. The microprocessor selects each amplifier channel 17, 19, 21, 23 in turn by adjusting the gain to that channel to maximum, while setting the gain of the remaining channels to zero, by changing multiplexer constants in the DSP 28.

[0025] As a result of the clipping detection, the DSP 28 would then deliver appropriate signals to the microprocessor 27 in order to transmit control to microprocessor 29 to generate an indicia on the front control unit 12. In particular, the preferred embodiment includes a metering block 82 that communicates to a software comparer 86 that determines whether the threshold of clipping is at a high, normal, or low level as shown in Figure 4. The microprocessor 27 also reads the updated byte at the eight bit parallel bus 84 to initiate the generation of appropriate indicia at the front control unit 12.

[0026] In the preferred embodiment, a symbol such as an LCD sequence illustrating OPEN would be illuminated in the screen 66 to demonstrate an open circuit condition. Similarly, an LCD sequence illustrating SHRT may be indicated at display screen 66 in order to demonstrate a short circuit condition. A PASS symbol may be illuminated at display 66 in order to indicate that the diagnostic test has indicated a normal condition, and thus proper connection between the amplifier 34 and any of the speaker in the speaker set 80. If a plurality of speakers is included in the set, the symbols will be accompanied by LF (left front), RF (right front), LR (left rear) or RR (right rear) symbols in a similar manner.

[0027] Thus, the present invention provides a self-contained diagnostic method and apparatus for determining the status of the speaker-to-amplifier conductor connections. The apparatus 10 is provided with substantially no additional hardware features that would occupy instrument panel space. Moreover, the apparatus requires only programming rather than hardware in order to implement initiation of the diagnostic procedure through the front control unit 12 of known DSP radio systems. Only software need be incorporated in the programmable memory of the DSP of a previously known radio assembly in order to implement the control and display of the status of each speaker connection to the DSP radio.

[0028] As a result, the present invention provides a simple method and apparatus for testing the installation of a communication system, for example, an entertainment system in a motor vehicle, during production of the vehicle or during installation of the system without requiring special diagnostic equipment or additional hardware in the construction of each communication device.

Claims

1. A method for diagnosing an electrical connection between a power amplifier and a speaker in a communication system, comprising:

   initiating a diagnostic routine by selecting a predetermined input on a control unit;
   generating a predetermined tone signal in response to the input selected;
   applying said tone signal to said amplifier;
   detecting the output from said amplifier;
   varying the level of said tone signal;
   monitoring the level of tone signal at which clipping occurs at an output from the amplifier; and
   indicating whether clipping commences within a predetermined range of tone signal levels.

2. A method as claimed in claim 1 wherein the communication system is a DSP communication device.

3. A method as claimed in claim 2 wherein said DSP device is a radio.

4. A method as claimed in claim 1 wherein said varying step comprises decreasing the signal level until clipping is terminated.

5. A method as claimed in claim 1 wherein said indicating step comprises displaying a first indicia on said control unit for a detected output at a signal level above said predetermined range; and
   displaying a second indicia on said control unit for a detected output at a signal level below said predetermined range.

6. A method as claimed in claim 5 wherein said first display indicia is an open circuit indicia.

7. A method as claimed in claim 5, wherein said second display indicia is a short circuit indicia.

8. A method as claimed in claim 5, and further comprising displaying a third indicia on said control unit for a detected output at a signal level within said predetermined range.

9. A method as claimed in claim 1, wherein said generating step comprises generating a signal at a frequency generally inaudible to the human ear.

10. A method as claimed in claim 9, wherein said gen-

erating step generates a 19 KHz signal.

11. A method as claimed in claim 1, wherein said communication system comprises a plurality of speakers and said method comprises sequentially repeating said recited steps for each speaker.

12. A DSP communication system (10) comprising a diagnostic circuit to diagnose an electrical connection between a power amplifier (34) and a speaker (16,18,20,22) in the communication system, comprising;

a control unit (12) having means (58,60,62) to initiate a diagnostic routine by selecting a predetermined input on the control unit;
a DSP processor unit (28) including a programmed means to generate a predetermined test signal in response to the said predetermined input and to control the magnitude of the test signal; and
a DA converter (32) for applying the test signal to the power amplifier;

characterised by;

a detector connected at an output from the amplifier (34) for determining a threshold level at which said amplifier generates a clipped output;
a monitor (82,86) for determining the magnitude level of the test signal at the threshold level of detected clipping; and
means (86) for indicating whether the amplifier (34) is properly coupled to a speaker (16,18,20,22) by comparing the detected level of the signal at clipping with a predetermined range of levels.

13. A communication system as claimed in claim 12, wherein said means to initiate a diagnostic routine comprises means to respond to a key press of keys on the control unit.

14. A communication system as claimed in claim 13, wherein the key press is a multi-switch actuation.

15. A communication system as claimed in claim 12, wherein the system comprises a plurality of audio channels and switch means for serially selecting each of said audio channels for diagnosis.

16. A communication system as claimed in claim 12, 13, 14 or 15, wherein the system is a DSP radio system, the DSP processor unit is adapted to generate a test signal which is a tone signal and the said predetermined range of levels includes an upper limit at which the amplifier-to-speaker connection is open-circuited, a lower limit at which the amplifier-to-speaker connection is short circuited, and a normal range between said upper and lower limits.

Patentansprüche

1. Verfahren zur Diagnose einer elektrischen Verbindung zwischen einem Leistungsverstärker und einem Lautsprecher in einem Kommunikationssystem, folgendes aufweisend:

das Auslösen einer Diagnoseroutine durch Anwahl einer vorgegebenen Eingabe an einer Bedieneinheit;
Erzeugen eines vorgegebenen Tonsignals in Reaktion auf die gewählte Eingabe;
Anlegen des besagten Tonsignales an besagten Verstärker;
Erfassen des Ausganges des besagten Verstärkers;
Verändern des Pegels des besagten Tonsignales;
Überwachen desjenigen Tonsignalpegels, bei dem Kappen an einem Ausgang des Verstärkers auftritt; und
Anzeigen, ob das Kappen in einem vorgegebenen Bereich von Tonsignalpegeln beginnt.

2. Verfahren nach Anspruch 1, worin das Kommunikationssystem eine DSP-Kommunikationsvorrichtung ist.

3. Verfahren nach Anspruch 2, worin besagte DSP-Vorrichtung ein Radio ist.

4. Verfahren nach Anspruch 1, worin besagter Änderungsschritt beinhaltet, den Signalpegel zu reduzieren, bis das Kappen aufhört.

5. Verfahren nach Anspruch 1, worin besagter Anzeigeschritt beinhaltet, ein erstes Hinweissignal an besagter Bedieneinheit anzuzeigen, wenn ein Ausgang mit einem Signalpegel über dem besagten vorgegebenen Bereich erfaßt wird; und
Anzeigen eines zweiten Hinweissignales an besagter Bedieneinheit, wenn ein Ausgang mit einem Signalpegel unter besagtem vorgegebenem Bereich erfaßt wird.

6. Verfahren nach Anspruch 5, worin besagtes erstes Hinweissignal ein Hinweis auf eine Unterbrechung der Verbindung ist.

7. Verfahren nach Anspruch 5, worin besagtes zweites Hinweissignal ein Hinweis auf einen Kurzschluß ist.

8. Verfahren nach Anspruch 5, außerdem die Anzeige eines dritten Hinweissignales an besagter Bedieneinheit beinhaltend, wenn ein Ausgang mit einem Signalpegel innerhalb des besagten vorgegebenen Bereiches erfaßt wird.

9. Verfahren nach Anspruch 1, in welchem der Schritt der Erzeugung die Erzeugung eines Signals beinhaltet, das für das menschliche Ohr allgemein unhörbar ist.

10. Verfahren nach Anspruch 9, worin besagter Schritt der Erzeugung ein 19 kHz-Signal erzeugt.

11. Verfahren nach Anspruch 1, worin besagtes Kommunikationssystem mehrere Lautsprecher beinhaltet, und besagtes Verfahren die sequentielle Wiederholung der besagten oben aufgeführten Schritte für jeden einzelnen Lautsprecher beinhaltet.

12. DSP-Kommunikationssystem (10) mit einer Diagnoseschaltung zur Diagnose einer elektrischen Verbindung zwischen einem Leistungsverstärker (34) und einem Lautsprecher (16, 18, 10, 22) im Kommunikationssystem, folgendes aufweisend:

eine Bedieneinheit (12) mit Mitteln (58, 60, 62) zur Einleitung einer Diagnoseroutine durch Anwahl einer vorgegebenen Eingabe an der Bedieneinheit;
eine DSP-Prozessoreinheit (28) mit programmierten Mitteln zur Erzeugung eines vorgegebenen Testsignales in Reaktion auf die besagte vorgegebene Eingabe und zur Steuerung der Größe des Testsignals; und
einen D/A-Wandler (32) zum Anlegen des Testsignales an den Leistungsverstärker;

gekennzeichnet durch

einen mit einem Ausgang des Verstärkers (34) verbundenen Detektor zur Bestimmung eines Schwellenpegels, ab welchem der besagte Verstärker ein gekapptes Ausgangssignal erzeugt;
eine Überwachungsschaltung (82, 86) zur Bestimmung der Höhe des Testsignalpegels an demjenigen Schwellenpegel, an dem Kappen festgestellt wird; und
Mittel (86) zur Anzeige, ob der Verstärker (34) richtig mit einem Lautsprecher (16, 18, 20, 22) verbunden ist, indem der erfaßte Signalpegel beim Kappen mit einem vorgegebenen Bereich von Pegeln verglichen wird.

13. Kommunikationssystem nach Anspruch 12, worin besagte Mittel zur Einleitung einer Diagnoseroutine Mittel aufweisen, die auf einen Tastendruck an der Bedieneinheit ansprechen.

14. Kommunikationssystem nach Anspruch 13, worin der Tastendruck eine Mehrtastenbetätigung ist.

15. Kommunikationssystem nach Anspruch 12, worin das System mehrere Hörtonkanäle und Schaltermittel für die serielle Anwahl eines jeden der besagten Hörtonkanäle für die Diagnose beinhaltet.

16. Kommunikationssystem nach Anspruch 12, 13, 14 oder 15, worin das System ein DSP-Radiosystem ist, die DSP-Prozessoreinheit dazu ausgelegt ist, ein durch ein Tonsignal gebildetes Testsignal zu erzeugen, und worin der besagte vorgegebene Bereich von Pegeln eine obere Grenze aufweist, ab welcher die Verstärker-Lautsprecher-Verbindung unterbrochen ist, eine untere Grenze, ab welcher die Verstärker-Lautsprecher-Verbindung kurzgeschlossen ist, und einen normalen Bereich zwischen besagter oberer und unterer Grenze.

Revendications

1. Procédé destiné à diagnostiquer une connexion électrique entre un amplificateur de puissance et un haut-parleur dans un système de communication, comprenant :

le lancement d'un sous-programme de diagnostic en sélectionnant une entrée prédéterminée sur une unité de commande,
la génération d'un signal à fréquence vocale prédéterminé en réponse à l'entrée sélectionnée,
l'application dudit signal à fréquence vocale audit amplificateur,
la détection de la sortie provenant dudit amplificateur,
la variation du niveau dudit signal à fréquence vocale,
la surveillance du niveau du signal à fréquence vocale auquel un écrêtage se produit au niveau d'une sortie provenant de l'amplificateur, et
l'indication du fait qu'un écrêtage commence à l'intérieur d'une plage prédéterminée de niveaux de signaux à fréquence vocale.

2. Procédé selon la revendication 1, dans lequel le système de communication est un dispositif de traitement numérique des signaux (DSP) de communication.

3. Procédé selon la revendication 2, dans lequel ledit dispositif de traitement numérique des signaux est une radio.

4. Procédé selon la revendication 1, dans lequel ladite étape de variation comprend la diminution du niveau de signal jusqu'à ce que l'écrêtage soit terminé.

5. Procédé selon la revendication 1, dans lequel ladite étape d'indication comprend l'affichage d'un premier indice sur ladite unité de commande en vue d'une sortie détectée à un niveau de signal au-dessus de ladite plage prédéterminée, et

l'affichage d'un second indice sur ladite unité de commande en vue d'une sortie détectée à un niveau de signal en-dessous de ladite plage prédéterminée.

6. Procédé selon la revendication 5, dans lequel ledit premier indice d'affichage est un indice de circuit ouvert.

7. Procédé selon la revendication 5, dans lequel ledit second indice d'affichage est un indice de court-circuit.

8. Procédé selon la revendication 5, et comprenant en outre l'affichage d'un troisième indice sur ladite unité de commande en vue d'une sortie détectée à un niveau de signal à l'intérieur de ladite plage prédéterminée.

9. Procédé selon la revendication 1, dans lequel ladite étape de génération comprend la génération d'un signal à une fréquence sensiblement inaudible pour l'oreille humaine.

10. Procédé selon la revendication 9, dans lequel ladite étape de génération génère un signal à 19 kHz.

11. Procédé selon la revendication 1, dans lequel ledit système de communication comprend une pluralité de haut-parleurs et ledit procédé comprend la répétition de façon séquentielle desdites étapes exposées pour chaque haut-parleur.

12. Système de traitement numérique des signaux (DSP) de communication (10) comprenant un circuit de diagnostic afin de diagnostiquer une connexion électrique entre un amplificateur de puissance (34) et un haut-parleur (16, 18, 20, 22) dans le système de communication, comprenant,

une unité de commande (12) comprenant un moyen (58, 60, 62) afin de lancer un sous-programme de diagnostic en sélectionnant une entrée prédéterminée sur l'unité de commande,
une unité de processeur de traitement numérique des signaux (28) comprenant un moyen programmé afin de générer un signal de test prédéterminé en réponse à ladite entrée prédéterminée et afin de commander l'amplitude du signal de test, et
un convertisseur numérique vers analogique (DA) (32) destiné à appliquer le signal de test à l'amplificateur de puissance,

caractérisé par

un détecteur relié à une sortie provenant de l'amplificateur (34) destiné à déterminer un niveau de seuil auquel ledit amplificateur génère une sortie écrêtée,
un dispositif de surveillance (82, 86) destiné à déterminer le niveau d'amplitude du signal de test au niveau de seuil de l'écrêtage détecté, et
un moyen (86) destiné à indiquer si l'amplificateur (34) est relié de façon appropriée à un haut-parleur (16, 18, 20, 22) en comparant le niveau détecté du signal à l'écrêtage à une plage prédéterminée de niveaux.

13. Système de communication selon la revendication 12, dans lequel ledit moyen pour lancer un sous-programme de diagnostic comprend un moyen pour répondre à un enfoncement de touches sur l'unité de commande.

14. Système de communication selon la revendication 13, dans lequel l'enfoncement de touches est un actionnement à commutateurs multiples.

15. Système de communication selon la revendication 12, dans lequel le système comprend une pluralité de canaux audio et un moyen de commutation destiné à sélectionner en série chacun desdits canaux audio en vue d'un diagnostic.

16. Système de communication selon la revendication 12, 13, 14 ou 15, dans lequel le système est un système radio de traitement numérique des signaux, l'unité de processeur de traitement numérique des signaux est conçue pour générer un signal de test qui est un signal à fréquence vocale et ladite plage prédéterminée de niveaux comprend une limite supérieure à laquelle la connexion amplificateur à haut-parleur est en circuit ouvert, une limite inférieure à laquelle la connexion amplificateur à haut-parleur est en court-circuit et une plage normale entre lesdites limites supérieure et inférieure.

FIG 1

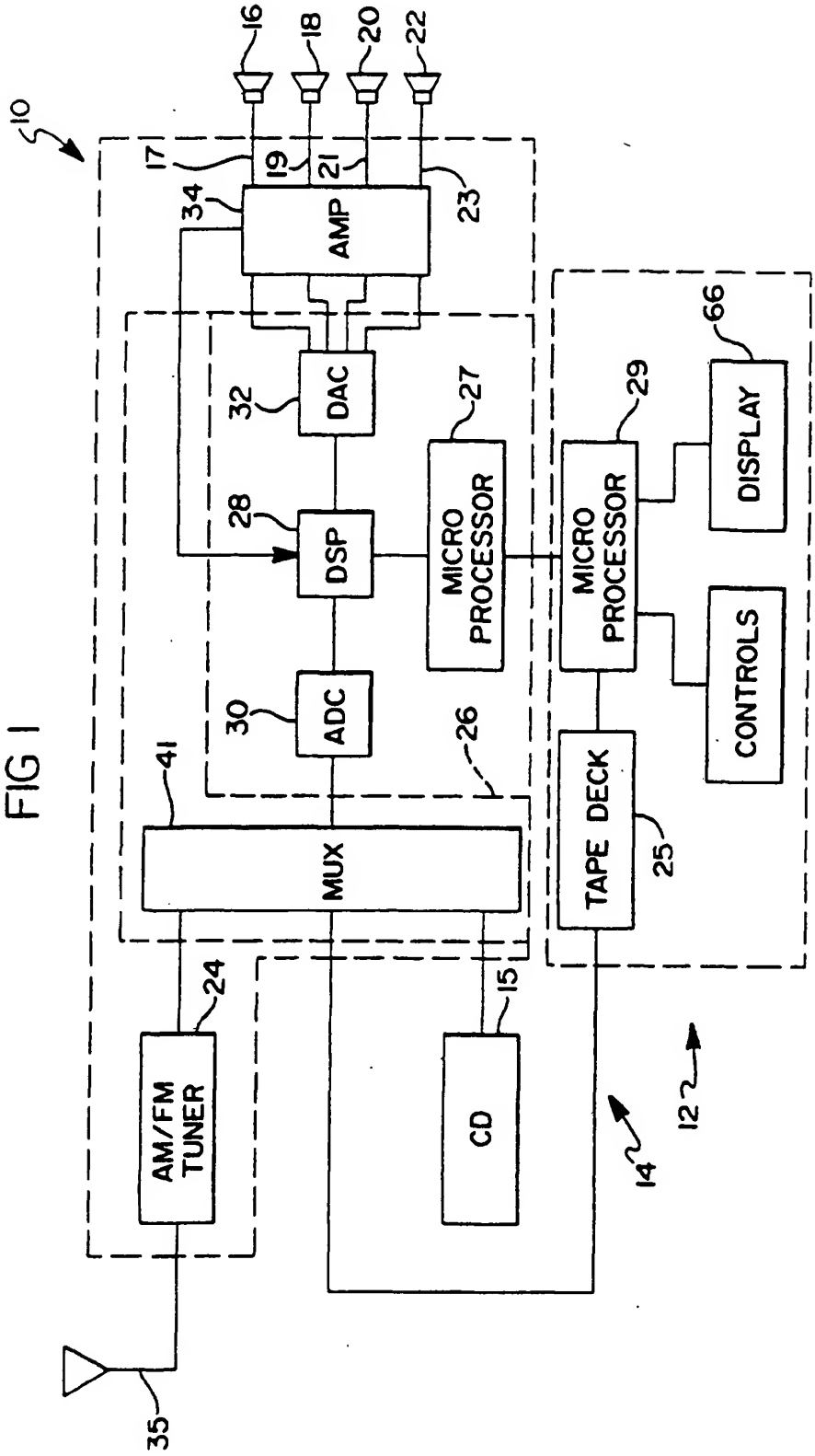
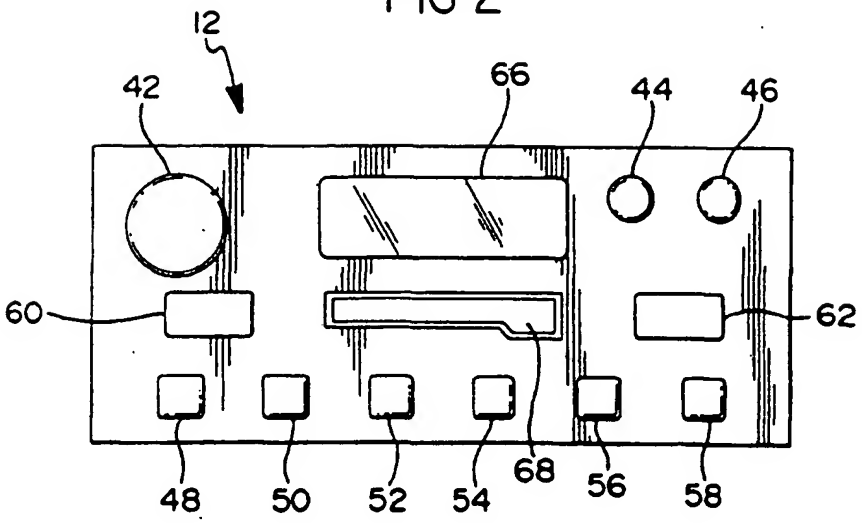

10
16
18
20
22
17
19
21
23
34
AMP
32
DAC
28
DSP
27
MICRO PROCESSOR
30
ADC
26
41
MUX
24
AM/FM TUNER
15
CD
35
29
MICRO PROCESSOR
66
DISPLAY
CONTROLS
TAPE DECK
25
12
14

FIG 2


12
42
66
44
46
60
62
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50
52
54
68
56
58

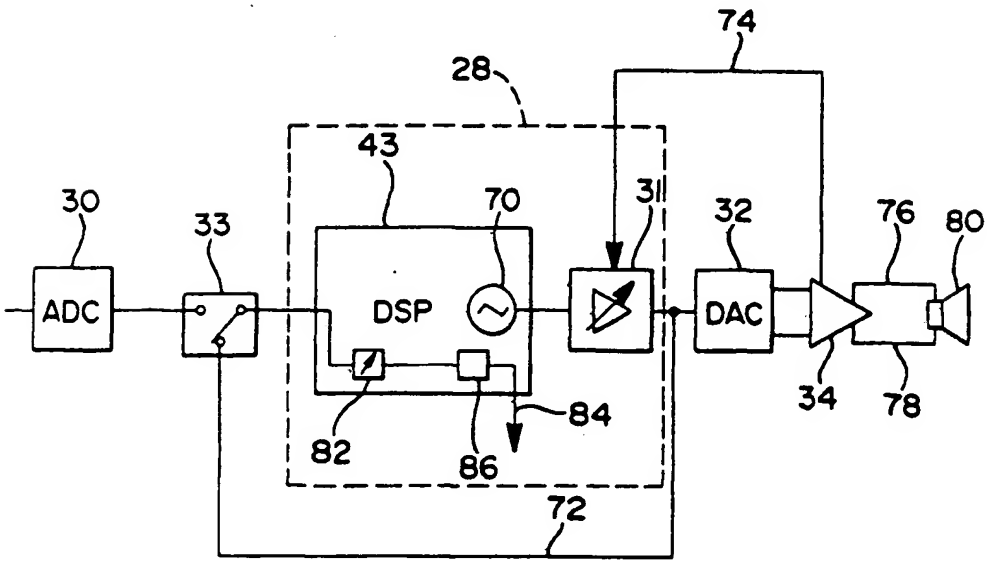
74
28
43
30
33
70
31
32
76
80
ADC
DSP
DAC
34
78
84
82
86
72

FIG 3

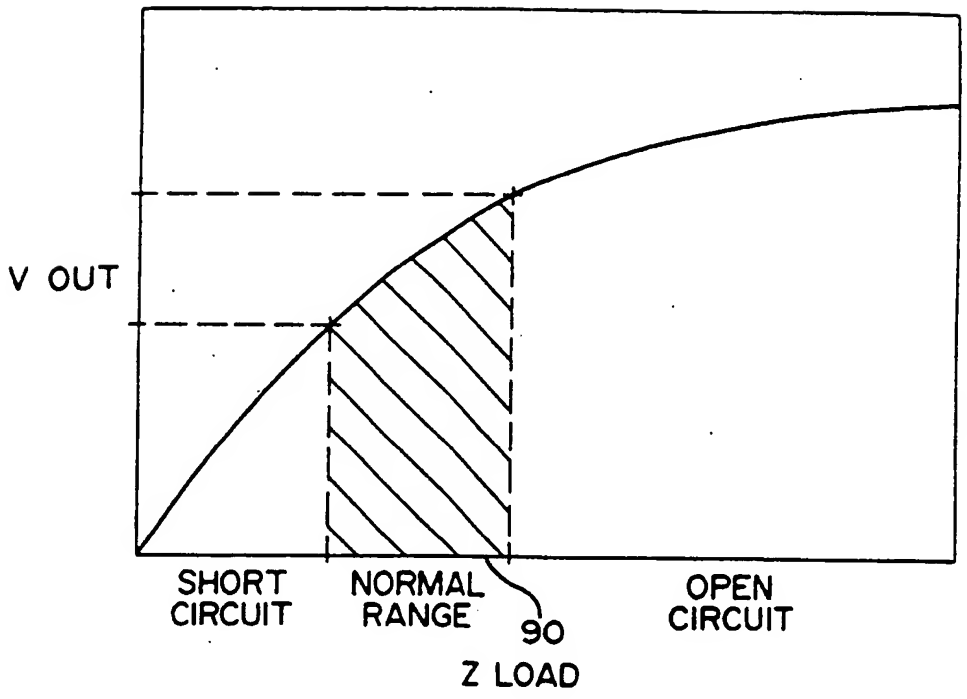

FIG 4